

## General

### Guideline Title

ACR Appropriateness Criteria® suspected physical abuse — child.

### Bibliographic Source(s)

Meyer JS, Coley BD, Karmazyn B, Binkovitz LA, Dempsey-Robertson ME, Dillman JR, Dory CE, Garber M, Hayes LL, Keller MS, Kulkarni AV, Milla SS, Myseros JS, Paidas C, Widmann RF, Raske ME, Rigsby CK, Strouse PJ, Wootton-Gorges SL, Expert Panel on Pediatric Imaging. ACR Appropriateness Criteria® suspected physical abuse -- child. [online publication]. Reston (VA): American College of Radiology (ACR); 2012. 9 p. [50 references]

### Guideline Status

Note: This guideline has been updated. The National Guideline Clearinghouse (NGC) is working to update this summary.

## Recommendations

### Major Recommendations




Note: This guideline has been updated. The National Guideline Clearinghouse (NGC) is working to update this summary. The recommendations that follow are based on the previous version of the guideline.

ACR Appropriateness Criteria®

Clinical Condition: Suspected Physical Abuse — Child






Variant 1: Child 24 months of age or younger, no focal neurologic signs or symptoms.

Radiologic Procedure	Rating	Comments	RRL*
X-ray skeletal survey	9		⊕⊕⊕⊕
CT head without contrast	7	Particularly for patients who are at "high risk" (e.g., with rib fractures, multiple fractures, facial injury, or less than 6 months of age).	⊕⊕⊕
MRI head without contrast	5	If further evaluation is indicated after CT examination.	O
MRI head without and with contrast	5	If further evaluation is indicated after CT examination. Administration of contrast is suggested if indicated due to prior CT findings or findings on noncontrast portion of MRI. See statement regarding contrast in text under "Anticipated Exceptions."	O

Radiologic Procedure	Rating	Comments	RRL*
Tc-99m bone scan whole body		If skeletal survey is negative and high clinical suspicion remains.	
CT head without and with contrast	1		
CT head with contrast	1		
<b>Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate</b>			<b>*Relative Radiation Level</b>






Note: Abbreviations used in the tables are listed at the end of the "Major Recommendations" field.

Variant 2: Child 24 months of age or younger, head trauma by history, no focal neurologic signs or symptoms, no evidence of visceral injury.

Radiologic Procedure	Rating	Comments	RRL*
X-ray skeletal survey	9		
CT head without contrast	9		
MRI head without contrast	6	If further evaluation is indicated after CT examination.	O
MRI head without and with contrast	6	If further evaluation is indicated after CT examination. Administration of contrast suggested if indicated due to prior CT findings or findings on noncontrast portion of MRI. See statement regarding contrast in text under "Anticipated Exceptions."	O
Tc-99m bone scan whole body	4	If skeletal survey is negative and high clinical suspicion remains.	
CT head without and with contrast	1		
CT head with contrast	1		
<b>Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate</b>			<b>*Relative Radiation Level</b>

Note: Abbreviations used in the tables are listed at the end of the "Major Recommendations" field.

Variant 3: Child 24 months of age or younger, with seizures or neurologic signs and symptoms, with or without physical findings.

Radiologic Procedure	Rating	Comments	RRL*
X-ray skeletal survey	9		
CT head without contrast	9		
MRI head without contrast	8	Do not defer head CT to await MRI in symptomatic child. May be useful whether CT is positive or negative.	O
MRI head without and with contrast	8	Do not defer head CT to await MRI in symptomatic child. May be useful whether CT is positive or negative. Administration of contrast suggested if indicated due to prior CT findings or findings on noncontrast portion of MRI. See statement regarding contrast in text under "Anticipated Exceptions."	O
Tc-99m bone scan whole body	4	If skeletal survey is negative and high clinical suspicion remains.	
CT head without and with contrast	1		
CT head with contrast	1		
<b>Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate</b>			<b>*Relative</b>

Radiologic Procedure	Rating	Comments	Radiation RRL Level
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Note: Abbreviations used in the tables are listed at the end of the "Major Recommendations" field.

Variant 4: Child older than 24 months of age, with seizures or neurologic signs and symptoms, with or without physical findings.

Radiologic Procedure	Rating	Comments	RRL*
CT head without contrast	9		☼☼☼
MRI head without contrast	8	Do not defer head CT to await MRI in symptomatic child. May be useful whether CT is positive or negative.	O
MRI head without and with contrast	8	Do not defer head CT to await MRI in symptomatic child. May be useful whether CT is positive or negative. Administration of contrast suggested if indicated due to prior CT findings or findings on noncontrast portion of MRI. See statement regarding contrast in text under "Anticipated Exceptions."	O
X-ray skeletal survey	6	Value of survey is less as age rises. Radiographs should usually be tailored to the area(s) of suspected injury.	☼☼☼
Tc-99m bone scan whole body	4	If skeletal survey is negative and high clinical suspicion remains.	☼☼☼
CT head without and with contrast	1		☼☼☼☼
CT head with contrast	1		☼☼☼
<b>Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate</b>			<b>*Relative Radiation Level</b>

Note: Abbreviations used in the tables are listed at the end of the "Major Recommendations" field.

Variant 5: Child 24 months of age or younger, with thoracic and/or abdominopelvic injuries, discrepancy with history.

Radiologic Procedure	Rating	Comments	RRL*
X-ray skeletal survey	9		☼☼☼
CT abdomen and pelvis with contrast	9		☼☼☼☼
CT head without contrast	8		☼☼☼
CT chest with contrast	6	When indicated based on abnormal chest radiograph and/or patient's signs and symptoms.	☼☼☼☼
MRI head without contrast	5	Do not defer head CT to await MRI in symptomatic child. May be useful whether CT is positive or negative.	O
MRI head without and with contrast	5	If further evaluation is indicated after CT examination. Administration of contrast suggested if indicated due to prior CT findings or findings on noncontrast portion of MRI. See statement regarding contrast in text under "Anticipated Exceptions."	O
CT abdomen and pelvis without and with contrast	1		☼☼☼☼
CT abdomen and pelvis without contrast	1	Should be considered only if there is an absolute contraindication to IV contrast administration.	☼☼☼☼
CT head without and with contrast	1		☼☼☼☼
<b>Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate</b>			<b>*Relative</b>

Radiologic Procedure	Rating	Comments	RRL
CT head with contrast CT chest without and with contrast	1		☢☢☢☢☢☢
CT chest without contrast	1		☢☢☢☢☢
<b>Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate</b>			<b>*Relative Radiation Level</b>

Note: Abbreviations used in the tables are listed at the end of the "Major Recommendations" field.

Variant 6: Child older than 24 months of age, with thoracic and/or abdominopelvic injuries, discrepancy with history.

Radiologic Procedure	Rating	Comments	RRL*
CT abdomen and pelvis with contrast	9		☢☢☢☢☢☢
CT head without contrast	8		☢☢☢☢☢
X-ray skeletal survey	6	Value of survey is less as age rises. Radiographs should usually be tailored to the area(s) of suspected injury.	☢☢☢☢
CT chest with contrast	6	When indicated based on abnormal chest radiograph and/or patient's signs and symptoms.	☢☢☢☢☢
MRI head without contrast	5	If further evaluation is indicated after CT examination.	O
MRI head without and with contrast	5	If further evaluation is indicated after CT examination. Administration of contrast suggested if indicated due to prior CT findings or findings on noncontrast portion of MRI. See statement regarding contrast in text under "Anticipated Exceptions."	O
CT abdomen and pelvis without and with contrast	1		☢☢☢☢☢☢
CT abdomen and pelvis without contrast	1	Should be considered only if there is an absolute contraindication to IV contrast administration.	☢☢☢☢☢☢
CT head without and with contrast	1		☢☢☢☢☢☢
CT head with contrast	1		☢☢☢☢☢
CT chest without and with contrast	1		☢☢☢☢☢☢
CT chest without contrast	1		☢☢☢☢☢☢
<b>Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate</b>			<b>*Relative Radiation Level</b>

Note: Abbreviations used in the tables are listed at the end of the "Major Recommendations" field.

## Summary of Literature Review

### Introduction/Background

In 2009, based on reports to child and protective service agencies, an estimated 702,000 children were victims of maltreatment (neglect, emotional abuse, sexual abuse, and physical abuse) in the United States. Of these children, 17.8% were victims of physical abuse and an estimated 1,770 children died from abuse or neglect. As high as these numbers are, the extent of the problem is actually much greater, as officially reported cases grossly understate the true incidence of abuse.

In some children, physical examination and history may clearly indicate that physical abuse has occurred. In other children, however, the diagnosis of physical abuse is not so straightforward. It requires consideration of possible underlying metabolic and genetic conditions and usually relies on the findings of a multidisciplinary team that includes physicians, social workers, and legal authorities. Imaging often plays a major role in the detection and documentation of physical injury. The type and extent of imaging performed in a child who is a suspected victim of abuse depend on

the child's age, signs, symptoms, and other social considerations such as being the twin of a physically abused infant.

Child abuse injuries can involve any site in the human body. Physically abused children may present with hollow viscus and solid-organ injuries, superficial and deep soft-tissue injuries, thermal injuries, and/or fractures. Fractures occur in up to 55% of child abuse victims. Fractures most often involve the long bones and ribs, with lesser involvement of the skull, clavicles, pelvis, and other bones.

Fractures that are highly specific for nonaccidental trauma in the normal child include those involving the ribs, metaphyseal or epiphyseal injuries, and avulsive fractures acromion process. Highly suggestive skeletal injuries include fractures that are unsuspected or inconsistent with the provided history or age of the child; multiple fractures involving more than one skeletal area; fractures of differing ages; and a combination of skeletal and nonskeletal injuries. In addition, fractures of the radius, ulna, tibia, fibula, or femur that occur in children younger than 1 year of age and midshaft or metaphyseal humeral fractures should be considered suspicious for abuse. A recent systematic review of the literature on fractures and child abuse found the child's motor developmental level to be a key discriminator for abuse in certain fractures. In particular, femoral fractures in a child who is not yet walking and unexplained humeral fractures in children younger than 15 months of age should be considered suspicious for abuse. This review also found that multiple rib fractures in any location without overt trauma were strongly associated with abusive injury, but that the posterior location of a rib fracture was not a discriminator for abuse.

### Radiographic Skeletal Survey

The radiographic skeletal survey is the primary imaging examination for detecting fractures. Compared with bone scintigraphy, the radiographic skeletal survey is more sensitive for detecting skull and metaphyseal long-bone fractures. The skeletal survey should be composed of frontal and lateral views of the skull, lateral views of the cervical spine (if not included on the lateral skull view) and thoracolumbosacral spine, and single frontal views of the long bones, chest, and abdomen. Oblique views of the ribs should be obtained to increase the accuracy of diagnosing rib fractures, which as previously noted are strong positive predictors and may be the only skeletal manifestation of abuse. The images should be obtained using high-detail imaging systems and coned to the specific area of interest for each of the body parts, with separate views of each arm, forearm, thigh, leg, hand, and foot to improve image quality and diagnostic accuracy (see Appendix 1 in the original guideline document).

The recommendations for use of skeletal surveys vary with the child's age and type of presentation. A majority of skeletal surveys that are positive for fractures are performed in children younger than 1 year of age, and 80% of children with fractures due to child abuse are younger than 18 months of age. Radiographic skeletal survey is recommended in all children younger than 2 years of age in whom there is suspicion of abuse. In children 2 to 5 years of age, performance of skeletal survey should be based on the presence of other clinical findings and the need to document the presence or absence of injuries. In this older group of children, however, skeletal imaging should be strongly considered in a child who has unexplained craniocerebral or abdominal injuries or fractures that are suspicious for abuse. In addition, a repeat skeletal survey performed approximately 2 weeks after the initial examination can provide additional information on the presence and age of child abuse fractures and should be performed when abnormal or equivocal findings are found on the initial study and when abuse is suspected on clinical grounds. These follow-up studies should include all the images except the skull radiographs that were included in the initial skeletal survey. Skull radiographs can be omitted since new findings would not be expected on these images.

### Bone Scintigraphy

Bone scintigraphy is a complementary examination for detecting bone injuries. It should be used when the radiographic skeletal survey is negative but clinical suspicion remains high and a search for further evidence of skeletal trauma is still necessary. To increase sensitivity, the bone scan should include the use of pinhole collimators and differential counts of the metaphyses. A bone scan is especially good for detecting periosteal trauma and rib, spine, pelvic, and acromion fractures.

### Head Trauma

Though less frequent than skeletal injuries, most child abuse fatalities are the result of head trauma, and head injury due to child abuse is the principal cause of death in children younger than 2 years of age. Subdural hematoma is the most commonly seen intracranial abnormality. Additional craniocerebral injuries include cerebral contusion, epidural hematoma, cerebral edema, subarachnoid hemorrhage, and unilateral hypoxic-ischemic injury.

Imaging the head in children with suspected abuse depends on the child's age and type of presentation. In children with skull fractures or clinical signs and symptoms of intracranial injury, an immediate noncontrast computed tomography (CT) scan of the head should be performed. If the CT scan does not detect significant lesions that require rapid neurosurgical intervention and the clinical presentation warrants further assessment, a magnetic resonance imaging (MRI) scan of the head should be performed. The MRI should include T1- and T2-weighted sequences with proton density or inversion recovery and gradient echo sequences. In addition, diffusion-weighted sequences are suggested to indicate whether acute cerebral injury is present. In a child with an abnormal CT, additional assessment with MRI should be considered to further assess the extent of post-traumatic injury.

There are varying opinions on how to image children who are suspected abuse victims and show no objective evidence suggesting intracranial injury. Children, especially those younger than 12 months of age, may have significant intracranial injury without signs or symptoms of head injury. Findings of physical examination, in particular the absence of retinal hemorrhages, should not be used to determine the need for imaging, as intracranial injury may occur in the absence of retinal hemorrhages. Skull radiographs are also unreliable. Though skull radiographs may detect fractures associated with intracranial pathology, they do not provide adequate screening, since significant traumatic intracranial pathology may occur in the absence of skull fractures.

In one study 37% of children younger than 2 years of age with "high-risk" criteria (defined as rib fractures, multiple fractures, facial injury, or younger than 6 months of age) and without overt signs of head injury who underwent head CT or MRI had occult head injury. In this study, 18 of the 19 children with occult head injury were younger than 1 year of age. Another study of 51 children younger than 4 years of age with no signs of intracranial injury who underwent skeletal survey for abuse found that 29% of those who underwent neuroimaging had evidence of intracranial injury that included subdural hematoma, epidural hematoma, or cerebral edema. Given these studies, clinicians should have a relatively low threshold for performing either CT or MRI of the head in children with suspected abuse. MRI avoids the radiation of CT and is a particularly good choice in the nonemergent setting to image these "high-risk" children without overt neurologic signs or symptoms.

### Nonskeletal Chest, Abdomen, and Pelvic Injuries

Nonskeletal injuries to the chest, abdomen, and pelvis can occur as the result of child abuse. Injuries to the chest are rare, but may include hemopericardium, cardiac contusions and lacerations, pleural effusion, lung contusions, and chylothorax. Nonskeletal injuries to the abdomen and pelvis include pancreatitis, pancreatic pseudocysts, and lacerations and contusions of the liver, adrenal gland, spleen, and kidneys as well as injury and rupture of the bladder and bowel. Clinical findings of abdominal pain, abdominal distension, vomiting, abdominal wall bruising, and hypoactive or absent bowel sounds may be seen in children with intra-abdominal injury. Abnormal liver transaminases and pancreatic enzymes suggest the presence of occult abdominal trauma. Victims of nonaccidental abdominal trauma tend to be younger and have a more delayed presentation than those who experience accidental trauma. The delay in presentation may be related to the caretaker's delay in bringing the patient to medical attention, inconsistent history, or the vagueness of symptoms that may accompany the injuries. In addition, independent of concomitant injury, blunt trauma due to child abuse is associated with a six-fold increase in odds of death compared to children whose injuries resulted from other mechanisms.

In most cases, imaging for assessing these injuries will be directed by the patient's clinical presentation or concerning findings on conventional radiographs and consists of a CT scan of the involved body part. CT scan of the chest should generally be performed with intravenous (IV) contrast to detect vascular injuries. CT scan for suspected intra-abdominal injury should include both the abdomen and pelvis and should be performed with IV contrast. The need for oral contrast is at the discretion of the radiologist, and its use should be strongly considered when there is concern for duodenal hematoma. Parenchymal or late arterial phase imaging is most helpful for detecting solid-organ injury. Delayed, excretory phase imaging is recommended if imaging findings suggest disruption of the genitourinary tract. In patients with spinal injury, either CT or MRI should be performed, depending on the severity of the patient's signs and symptoms. CT scan is recommended to assess fractures. MRI is the preferred imaging examination to assess the spinal cord in the presence of neurologic deficits.

Child abuse should be considered in any age child with thoracoabdominal injuries that are not consistent with the provided history. A skeletal survey can be helpful by detecting the presence of other injuries and may confirm the diagnosis of abuse. As a result, skeletal survey is recommended in children 24 months of age or younger when an apparently isolated thoracoabdominal injury is found and raises the possibility of physical abuse. In addition, a skeletal survey should be strongly considered in older patients in the same clinical setting.

### Summary

- The appropriate imaging of pediatric patients being evaluated for suspected physical abuse depends on the age of the child, the presence of neurologic signs and symptoms, evidence of thoracic or abdominopelvic injuries, and whether the child's injuries are discrepant with the clinical history.
- An x-ray skeletal survey is always indicated in a child 24 months of age, or younger. In older children, a skeletal survey can be performed, but it is often more appropriate to tailor the radiographs to the area(s) of suspected injury.
- CT scan of the head without contrast is always indicated in a patient with seizures or neurologic signs and symptoms and when there is a history of head trauma.
- CT scan of the head should be strongly considered in "high-risk" children (rib fractures, multiple fractures, facial injury, or are 6 months of age, or younger) and children with thoracic and/or abdominopelvic injuries and a discrepant clinical history.
- MRI of the head may be needed for further assessment after a head CT and may be useful whether the head CT is positive or negative. When the child is symptomatic, however, the head CT should not be delayed if an MRI is to be obtained.
- Whole-body Technetium (Tc)-99m bone scan may be helpful if the x-ray skeletal survey is negative and a high clinical suspicion remains.
- CT scans of the chest, abdomen, and/or pelvis are indicated if there are signs and symptoms of abuse or if abnormal findings are seen on

conventional radiography, particularly when there is a discrepancy with clinical history.

- CT scan of the abdomen and pelvis should always be performed with IV contrast unless the patient has an absolute contraindication to it.

#### Anticipated Exceptions

Nephrogenic systemic fibrosis (NSF) is a disorder with a scleroderma-like presentation and a spectrum of manifestations that can range from limited clinical sequelae to fatality. It appears to be related to both underlying severe renal dysfunction and the administration of gadolinium-based contrast agents. It has occurred primarily in patients on dialysis, rarely in patients with very limited glomerular filtration rate (GFR) (i.e.,  $<30 \text{ mL/min/1.73 m}^2$ ), and almost never in other patients. There is growing literature regarding NSF. Although some controversy and lack of clarity remain, there is a consensus that it is advisable to avoid all gadolinium-based contrast agents in dialysis-dependent patients unless the possible benefits clearly outweigh the risk, and to limit the type and amount in patients with estimated GFR rates  $<30 \text{ mL/min/1.73 m}^2$ . For more information, please see the American College of Radiology (ACR) Manual on Contrast Media (see the "Availability of Companion Documents" field).

#### Abbreviations

- CT, computed tomography
- IV, intravenous
- MRI, magnetic resonance imaging
- Tc, technetium

#### Relative Radiation Level Designations

Relative Radiation Level*	Adult Effective Dose Estimate Range	Pediatric Effective Dose Estimate Range
O	0 mSv	0 mSv
☢	$<0.1 \text{ mSv}$	$<0.03 \text{ mSv}$
☢ ☢	0.1-1 mSv	0.03-0.3 mSv
☢ ☢ ☢	1-10 mSv	0.3-3 mSv
☢ ☢ ☢ ☢	10-30 mSv	3-10 mSv
☢ ☢ ☢ ☢ ☢	30-100 mSv	10-30 mSv

\*RRL assignments for some of the examinations cannot be made, because the actual patient doses in these procedures vary as a function of a number of factors (e.g., region of the body exposed to ionizing radiation, the imaging guidance that is used). The RRLs for these examinations are designated as "Varies."

## Clinical Algorithm(s)

Algorithms were not developed from criteria guidelines.

## Scope

### Disease/Condition(s)

Suspected physical abuse of children

### Guideline Category

Diagnosis

Evaluation

# Clinical Specialty

Family Practice

Neurology

Pediatrics

Radiology

## Intended Users

Health Plans

Hospitals

Managed Care Organizations

Physicians

Utilization Management

## Guideline Objective(s)

To evaluate the appropriateness of initial radiologic examinations for children suspected of being physically abused

## Target Population

Children suspected of being physically abused

## Interventions and Practices Considered

1. X-ray skeletal survey
2. Computed tomography (CT)
  - Head with contrast
  - Head without contrast
  - Head without and with contrast
  - Abdomen and pelvis with contrast
  - Abdomen and pelvis without contrast
  - Abdomen and pelvis without and with contrast
  - Chest with contrast
  - Chest without contrast
  - Chest without and with contrast
3. Magnetic resonance imaging (MRI)
  - Head without contrast
  - Head without and with contrast
4. Technetium (Tc)-99m bone scan whole body

## Major Outcomes Considered

Utility of radiologic examinations in differential diagnosis

## Methodology



## Methods Used to Collect/Select the Evidence

### Searches of Electronic Databases

## Description of Methods Used to Collect/Select the Evidence

### Literature Search Procedure

The Medline literature search is based on keywords provided by the topic author. The two general classes of keywords are those related to the condition (e.g., ankle pain, fever) and those that describe the diagnostic or therapeutic intervention of interest (e.g., mammography, MRI).

The search terms and parameters are manipulated to produce the most relevant, current evidence to address the American College of Radiology Appropriateness Criteria (ACR AC) topic being reviewed or developed. Combining the clinical conditions and diagnostic modalities or therapeutic procedures narrows the search to be relevant to the topic. Exploding the term "diagnostic imaging" captures relevant results for diagnostic topics.

The following criteria/limits are used in the searches.

1. Articles that have abstracts available and are concerned with humans.
2. Restrict the search to the year prior to the last topic update or in some cases the author of the topic may specify which year range to use in the search. For new topics, the year range is restricted to the last 5 years unless the topic author provides other instructions.
3. May restrict the search to Adults only or Pediatrics only.
4. Articles consisting of only summaries or case reports are often excluded from final results.

The search strategy may be revised to improve the output as needed.

## Number of Source Documents

The total number of source documents identified as the result of the literature search is not known.

## Methods Used to Assess the Quality and Strength of the Evidence

### Weighting According to a Rating Scheme (Scheme Given)

## Rating Scheme for the Strength of the Evidence

### Strength of Evidence Key

Category 1 - The conclusions of the study are valid and strongly supported by study design, analysis and results.

Category 2 - The conclusions of the study are likely valid, but study design does not permit certainty.

Category 3 - The conclusions of the study may be valid but the evidence supporting the conclusions is inconclusive or equivocal.

Category 4 - The conclusions of the study may not be valid because the evidence may not be reliable given the study design or analysis.

## Methods Used to Analyze the Evidence

### Systematic Review with Evidence Tables

## Description of the Methods Used to Analyze the Evidence

The topic author drafts or revises the narrative text summarizing the evidence found in the literature. American College of Radiology (ACR) staff draft an evidence table based on the analysis of the selected literature. These tables rate the strength of the evidence for all articles included in the narrative text.

The expert panel reviews the narrative text, evidence table, and the supporting literature for each of the topic-variant combinations and assigns an appropriateness rating for each procedure listed in the table. Each individual panel member forms his/her own opinion based on his/her interpretation of the available evidence.

More information about the evidence table development process can be found in the ACR Appropriateness Criteria® Evidence Table Development document (see the "Availability of Companion Documents" field).

## Methods Used to Formulate the Recommendations

Expert Consensus (Delphi)

### Description of Methods Used to Formulate the Recommendations

Modified Delphi Technique

The appropriateness ratings for each of the procedures included in the Appropriateness Criteria topics are determined using a modified Delphi methodology. A series of surveys are conducted to elicit each panelist's expert interpretation of the evidence, based on the available data, regarding the appropriateness of an imaging or therapeutic procedure for a specific clinical scenario. American College of Radiology (ACR) staff distributes surveys to the panelists along with the evidence table and narrative. Each panelist interprets the available evidence and rates each procedure. The surveys are completed by panelists without consulting other panelists. The ratings are a scale between 1 and 9, which is further divided into three categories: 1, 2, or 3 is defined as "usually not appropriate"; 4, 5, or 6 is defined as "may be appropriate"; and 7, 8, or 9 is defined as "usually appropriate." Each panel member assigns one rating for each procedure per survey round. The surveys are collected and the results are tabulated, de-identified and redistributed after each round. A maximum of three rounds are conducted. The modified Delphi technique enables each panelist to express individual interpretations of the evidence and his or her expert opinion without excessive bias from fellow panelists in a simple, standardized and economical process.

Consensus among the panel members must be achieved to determine the final rating for each procedure. Consensus is defined as eighty percent (80%) agreement within a rating category. The final rating is determined by the median of all the ratings once consensus has been reached. Up to three ratings rounds are conducted to achieve consensus.

If consensus is not reached, the panel is convened by conference call. The strengths and weaknesses of each imaging procedure that has not reached consensus are discussed and a final rating is proposed. If the panelists on the call agree, the rating is proposed as the panel's consensus. The document is circulated to all the panelists to make the final determination. If consensus cannot be reached on the call or when the document is circulated, "No consensus" appears in the rating column and the reasons for this decision are added to the comment sections.

### Rating Scheme for the Strength of the Recommendations

Not applicable

### Cost Analysis

A formal cost analysis was not performed and published cost analyses were not reviewed.

### Method of Guideline Validation

Internal Peer Review

### Description of Method of Guideline Validation

Criteria developed by the Expert Panels are reviewed by the American College of Radiology (ACR) Committee on Appropriateness Criteria.

# Evidence Supporting the Recommendations

## Type of Evidence Supporting the Recommendations

The recommendations are based on analysis of the current literature and expert panel consensus.

## Benefits/Harms of Implementing the Guideline Recommendations

### Potential Benefits

Selection of appropriate radiologic imaging procedures for evaluation of children suspected of physical abuse

### Potential Harms

#### Gadolinium-based Contrast Agents

Nephrogenic systemic fibrosis (NSF) is a disorder with a scleroderma-like presentation and a spectrum of manifestations that can range from limited clinical sequelae to fatality. It appears to be related to both underlying severe renal dysfunction and the administration of gadolinium-based contrast agents. It has occurred primarily in patients on dialysis, rarely in patients with very limited glomerular filtration rate (GFR) (i.e.,  $<30$  mL/min/1.73 m<sup>2</sup>), and almost never in other patients. Although some controversy and lack of clarity remain, there is a consensus that it is advisable to avoid all gadolinium-based contrast agents in dialysis-dependent patients unless the possible benefits clearly outweigh the risk, and to limit the type and amount in patients with estimated GFR rates  $<30$  mL/min/1.73 m<sup>2</sup>. For more information, please see the American College of Radiology (ACR) Manual on Contrast Media (see the "Availability of Companion Documents" field).

#### Relative Radiation Level (RRL)

Potential adverse health effects associated with radiation exposure are an important factor to consider when selecting the appropriate imaging procedure. Because there is a wide range of radiation exposures associated with different diagnostic procedures, a RRL indication has been included for each imaging examination. The RRLs are based on effective dose, which is a radiation dose quantity that is used to estimate population total radiation risk associated with an imaging procedure. Patients in the pediatric age group are at inherently higher risk from exposure, both because of organ sensitivity and longer life expectancy (relevant to the long latency that appears to accompany radiation exposure). For these reasons, the RRL dose estimate ranges for pediatric examinations are lower as compared to those specified for adults. Additional information regarding radiation dose assessment for imaging examinations can be found in the ACR Appropriateness Criteria® Radiation Dose Assessment Introduction document (see the "Availability of Companion Documents" field).

## Qualifying Statements

### Qualifying Statements

The American College of Radiology (ACR) Committee on Appropriateness Criteria and its expert panels have developed criteria for determining appropriate imaging examinations for diagnosis and treatment of specified medical condition(s). These criteria are intended to guide radiologists, radiation oncologists, and referring physicians in making decisions regarding radiologic imaging and treatment. Generally, the complexity and severity of a patient's clinical condition should dictate the selection of appropriate imaging procedures or treatments. Only those examinations generally used for evaluation of the patient's condition are ranked. Other imaging studies necessary to evaluate other co-existent diseases or other medical consequences of this condition are not considered in this document. The availability of equipment or personnel may influence the selection of appropriate imaging procedures or treatments. Imaging techniques classified as investigational by the U.S. Food and Drug Administration (FDA) have not been considered in developing these criteria; however, study of new equipment and applications should be encouraged. The ultimate decision regarding the appropriateness of any specific radiologic examination or treatment must be made by the referring physician and radiologist in light of all the circumstances presented in an individual examination.

# Implementation of the Guideline

## Description of Implementation Strategy

An implementation strategy was not provided.

## Institute of Medicine (IOM) National Healthcare Quality Report Categories

### IOM Care Need

Getting Better

### IOM Domain

Effectiveness

## Identifying Information and Availability

### Bibliographic Source(s)

Meyer JS, Coley BD, Karmazyn B, Binkovitz LA, Dempsey-Robertson ME, Dillman JR, Dory CE, Garber M, Hayes LL, Keller MS, Kulkarni AV, Milla SS, Myseros JS, Paidas C, Widmann RF, Raske ME, Rigsby CK, Strouse PJ, Wootton-Gorges SL, Expert Panel on Pediatric Imaging. ACR Appropriateness Criteria® suspected physical abuse -- child. [online publication]. Reston (VA): American College of Radiology (ACR); 2012. 9 p. [50 references]

### Adaptation

Not applicable: The guideline was not adapted from another source.

### Date Released

1995 (revised 2012)

### Guideline Developer(s)

American College of Radiology - Medical Specialty Society

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### Guideline Committee

Committee on Appropriateness Criteria, Expert Panel on Pediatric Imaging

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## Financial Disclosures/Conflicts of Interest

Not stated

## Guideline Status

Note: This guideline has been updated. The National Guideline Clearinghouse (NGC) is working to update this summary.

## Guideline Availability

The updated guideline is available from the [American College of Radiology \(ACR\) Web site](#) .

Print copies: Available from the American College of Radiology, 1891 Preston White Drive, Reston, VA 20191. Telephone: (703) 648-8900.

## Availability of Companion Documents

The following are available:

- ACR Appropriateness Criteria®. Overview. Reston (VA): American College of Radiology; 2 p. Available from the [American College of Radiology \(ACR\) Web site](#) .
- ACR Appropriateness Criteria®. Literature search process. Reston (VA): American College of Radiology; 1 p. Available from the [ACR Web site](#) .
- ACR Appropriateness Criteria®. Evidence table development – diagnostic studies. Reston (VA): American College of Radiology; 2013 Nov. 3 p. Available from the [ACR Web site](#) .
- ACR Appropriateness Criteria®. Radiation dose assessment introduction. Reston (VA): American College of Radiology; 3 p. Available from the [ACR Web site](#) .
- ACR Appropriateness Criteria®. Manual on contrast media. Reston (VA): American College of Radiology; 90 p. Available from the [ACR Web site](#) .
- ACR Appropriateness Criteria®. Procedure information. Reston (VA): American College of Radiology; 1 p. Available from the [ACR Web site](#) .
- ACR Appropriateness Criteria® suspected physical abuse — child. Evidence table. Reston (VA): American College of Radiology; 2012. 12 p. Available from the [ACR Web site](#) .

## Patient Resources

None available

## NGC Status

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